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Catastrophe Futures: A Better Hedge for Insurers

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CATASTROPHE FUTURES: A BETTER HEDGE FOR INSURERS

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In June, 1990, the Chicago Board of Trade (CBOT) submitted for approval with the Commodity Futures Trading Commission two insurance futures contracts, one based on health insurance and one on automobile collision coverage. The proposed contracts would be based on the ratio of paid losses to written premium on policies written in a particular month. Under this proposal, information on a sample of policies would be collected from a group of insurers and disseminated regularly so futures traders could develop expectations of the ultimate settlement value. The final cash settlement on the futures would be based on the figures reported by the insurers as of four months after the policies had expired.

In February, 1991, the CBOT set a target date of October 1, 1991, to begin trading health insurance futures. However, in September, 1991, the CBOT announced a delay in the commencement of trading insurance futures. This paper will describe the initial futures contracts proposed by the CBOT, discuss the possible benefits of a functional insurance futures market, analyze the problems inherent in the proposed contracts and propose an alternative contract, based on insured losses from catastrophes, that avoids many of the problems that affected the initial insurance futures contracts.

Futures and the CBOT

Futures contracts are an institutionalized form of forward trading. Forward trading is simply the commitment of two parties

to engage in the purchase and sale of a good or another financial transaction at a stated future date. Forward contracting, particularly in agricultural commodities, can be traced to the times of the Roman empire and classical Greece. Trading in futures developed in the 1860s, initiated by the Chicago Board of Trade. The distinction between futures and forward contracts is based principally on four attributes of futures. First, futures are traded only on an organized exchange; twelve futures exchanges are active in the United States alone. Second, futures contracts are standardized as to the quality of the item to be delivered as well as the date and location of delivery. Next, a clearinghouse is involved in every futures trade and the commitment of each party to the trade is to the clearinghouse. The clearinghouse thus guarantees performance of the future transaction, reducing (eliminating, as claimed by futures exchanges) default risk. The final major difference between futures and forward contracts is that each day futures contracts are "marked to market". Any changes in the value of a position are reflected in the accounts of the traders at the end of every trading day.

Futures contracts are now traded on a variety of goods, ranging from the agricultural commodities that gave rise to this type of trading, to metals, petroleum, interest-bearing assets, foreign currencies and financial indices. Futures on financial indices, such as the Standard and Poor's 500 index, unlike more traditional futures contracts, cannot be fulfilled by physical delivery of the underlying commodity at expiration; instead each

trader's position is closed out by a reversing trade (e.g., selling all contracts held prior to expiration) or by cash settlement. The insurance futures contracts would be a form of financial index and have this attribute. For a more detailed introduction to futures contracts, see Kolb (1985).

The CBOT's Proposed Insurance Futures Contracts

The insurance futures contracts initially proposed by the CBOT for health insurance and automobile collision coverage were devised to follow the pattern of traditional financial futures contracts. Trading would begin in the month that the policies on which the index would be based were written. Positions would be marked to market daily, so that every day investors' accounts would be credited with any capital gains on their futures positions or be debited any capital losses that occurred that day. The contract would be based on the experience of a group of insurers on a sample of the policies they wrote that were effective in a given month. The final settlement value would be determined as follows four months after the policies expired:

$$\$100{,}000 * (1 - (\text{Claims paid}/\text{Premiums earned}))$$

The policy requirements for inclusion in the health insurance futures index included deductible levels, minimum benefits, coinsurance provisions, group size and a twelve month policy term.

The criteria for the automobile contract included deductible level, geographic distribution and a six month policy term. Thus, the health insurance future would trade for sixteen months (the twelve month policy term and four additional months for claims to be paid) and the automobile insurance future for ten months (six month policy term and four month settlement period). A manager would be appointed for each type of future to set up the pool of reporting insurers, collect the statistical information and calculate and disseminate the index value. Coopers and Lybrand was appointed to manage the health insurance pool.

Each month during the policy term, the insurers will report to the manager written premiums and paid claims on the sample of policies included in the pool. As the index is based on policies written in a particular month, most of the written premium will be included in the first monthly report. Subsequent endorsements and cancellations will affect the final written premium value, but these changes are likely to be minor. As the index is valued four months after the policy expires, all written premiums will have been earned by then. Thus, a fairly good estimate of earned premiums should be available early in the futures contract trading period. Paid claims will also be included in the monthly reports. As the final index value will be based on all claims that have been paid by the insurer and reported to the pool manager by the deadline of four months after the expiration of the policies, some claims will not have been paid by then, and others will not have been included in the statistical reports for one reason or another.

It is unclear whether recoveries such as salvage and subrogation will be considered, but even if they are, the early cutoff will limit the amount of recoveries included. Thus, the settlement value will not be based on ultimate incurred losses, but on a partially developed paid loss figure. Interim reports will provide some information on the final index value, but the settlement value will be unknown until the final values are released. It is this uncertainty that makes this contract suitable for a futures market.

The value of the insurance futures at any point in time should represent the market consensus of the final settlement value. For example, if the expected value of paid claims to earned premium for health insurance policies issued in January, 1993, is 80 percent, then the futures contract should be priced at $20,000 [$100,000*(1-.80)]. If a flu epidemic occurred during the next twelve months, then the consensus might change to expect a ratio of 82 percent. This should drop the value of the futures contract to $18,000. Because the value of an insurance futures contract would be likely to mirror the costs of claims for individual insurers, automobile and health insurers could use the contract as a hedging mechanism. An insurer could protect itself from an increase in claims costs by selling an insurance futures contract (taking a short position). If a general increase in claims costs occurred, the value of the insurance futures contract would decrease. To reflect this change in value, the futures exchange would transfer the capital loss on the contract from those who bought futures contracts (the longs) to

those who sold (the shorts). This gain on the futures position would largely offset the unfavorable loss experience on written policies. Of course, if claims costs fell, the gain from the written policies would be offset by a loss on the futures position.

Potential Benefits of Insurance Futures

The original CBOT insurance futures proposal fostered a number of studies on the possible benefits of this contract. Hofflander, et al, (1991) examine how the insurance market would be affected by the availability of insurance futures and found that insurers would be willing to sell more insurance if a market for insurance futures existed, but the effect on prices was indeterminate. An important aspect of the benefit of the futures market was how closely the pool value varied in line with the insurer's own experience. The greatest benefit occurred if the values were highly correlated. Cox and Schwebach (1991) model the CBOT futures contract and options on the futures, and compare the benefits of these contracts to reinsurance. The futures are found to compare favorably to reinsurance in some regards, specifically liquidity, confidentiality and potentially lower transactions costs. Another potential advantage of insurance futures is the possibility of lowering the entry costs into the insurance business. An entity could participate in the market without having to become a licensed insurance carrier in various states. Also, insurance futures could, if used properly, decrease the risk of insurer insolvency.

However, the advantages of reinsurance, surplus aid, targeting specific geographic markets and perfect correlation with the ceding company's book of business, may limit the use of insurance futures by insurers.

Mann and Niehaus (1991) provide an excellent analysis of the original CBOT insurance futures proposal and demonstrate that, if the costs can be held low enough, then insurance futures offer the possibility of lowering insurance prices, reducing insolvency risk, lowering the required capital for insurers and increasing coverage for consumers. They find that insurance futures provide risk reduction possibilities beyond those currently available through reinsurance. Their paper also examines the practical regulatory issues involved in insurance futures that can be expected to impede the implementation of these contracts.

One shortcoming of the paper by Mann and Niehaus relates to the problem of asymmetric information between the insurers that report the statistical information used to generate the pool index and all other parties. In noting the potential problem of an insurer engaging in opportunistic behavior to take advantage of information about loss payments to profit on futures trades, they cite the fact that no one insurer will have more than 15 percent of the policies included in the pool and that opportunistic behavior may be a criminal offense. However, this informational asymmetry is a much more serious problem than recognized by Mann and Niehaus. As elaborated later in this paper, knowledge of the type of policies being reported to the pool, the company's monthly loss

ratio values and loss development patterns, and such seemingly innocuous items as report cutoff dates and claims department staffing, would provide a significant informational advantage that is likely to doom the current CBOT insurance futures proposal. To avoid the informational asymmetry, this paper details an alternative insurance futures index.

A number of other articles provide insights into the insurance futures market. Eramo (1991) describes how the CBOT proposal would function and indicates the significant impact on the insurance market that a successful insurance futures contract, especially one on longer tailed liability lines, would have. Rosenthal (1991a, 1991b, 1991c) and Hayes (1991) provide upbeat analyses of the potential of insurance futures. D'Arcy and France (1990) take a less sanguine view of the initially proposed CBOT contract.

Sherman (1990) presents some numerical examples of how insurance futures will function and a general description of the futures market. Lewis (1990) points out a number of misconceptions in Sherman's article, and these points are addressed in Sherman (1991a). In a later paper, Sherman (1991b) attempts to explain insurance futures to actuaries and relies on the Black-Scholes option pricing model to determine appropriate prices. This application of the Black-Scholes model to futures is incorrect, as noted by Cox (1991) and Robertson (1991).

The general view of the literature on insurance futures is that if an index that is highly correlated with nondiversifiable insurance risk could be established and a low transactions cost

insurance futures market could be maintained, then the risk involved in writing insurance could be more widely spread and reduced for individual insurers. This risk reduction tool would then lower insurance prices. Most articles recognize the potential benefits of a viable insurance futures contract.

Problems with the Initial Futures Contract Proposal

Many articles raised serious concerns about the viability of the initially proposed CBOT contract, in terms of the feasibility of creating the index, the correlation with insurers' nondiversifiable risk and the transactions costs. The insurance futures contract initially proposed by the CBOT required the development of a new data set on which the settlement price of the contract would be based. Thus, insurers and other futures market participants would not know how the values related to their own experience. With no knowledge of how the futures prices move in relation to the other risks of the company, developing hedge ratios and trading strategies to minimize total risk would be difficult.

The premium and loss values used to generate the insurance futures index would be reported periodically by the pool manager prior to the ultimate settlement value. Although insurers are familiar with working with incomplete data in using loss development factors to project ultimate loss experience, loss development factors are based on historical experience. Without historical experience, many insurers would be reluctant to

participate in insurance futures since the level of uncertainty would be so high. Thus, the insurance futures market would have to be functioning for several years before many potential participants would become involved as traders. Who would trade insurance futures in the meantime is a major concern.

Compiling the insurance futures indices for health and automobile insurance would require a minimum of ten insurers for each line to voluntarily report premium and loss information to the pool manager on a monthly basis so that no one insurer would have an inordinate impact on the index. Automobile insurers are already required to report detailed information to statistical or ratemaking agencies. The information required by the pool manager would be a subset of this information. However, generating the new reports would entail some expenses, especially in the initial programming to select the policies on which premium and loss information would be reported, as well as the ongoing computer runs and error checking. Three problems associated with generating this information are apparent.

First, the insurers reporting the information must be compensated in some way. Although the initial documentation produced by the CBOT indicated that insurers were expected to volunteer to provide this information, evidently the CBOT later decided to pay for this service. These payments raise the CBOT's administrative costs for the contract.

Second, the insurers reporting the data to the pool manager would have a significant information advantage over other traders.

When the contract is first listed for trading, the company would have a much better estimate of the expected loss ratio on its business than other futures traders. Even if traders knew what percent of the pool each reporting insurer composed, they would not know the monthly loss ratio of the reporting insurers for months leading up to the beginning of trading or the loss ratio on policies with similar characteristics to the sample that is reported. Traders would also not know the paid loss ratio as of four months after the policies expire. Such factors as the classification of the driver, deductible, rating territory and length of time a policy has been insured with the reporting insurer all affect the expected loss ratio on a book of automobile insurance.

Even after a pattern of development has been established, the reporting insurers would have a significant advantage over other traders. Historical development patterns are affected by the actual cutoff date for generating a monthly report (just before or after a weekend, around a holiday, etc.). The reporting insurers would know if they were understaffed compared to prior reporting periods, causing loss payments to be made at a slower rate. Any internal changes in claims processing, such as changing the dollar level of settlement authority for agents or office adjusters, adding or deleting coding requirements, or altering the caseload of adjusters, would affect the rate of claim payments. As the reporting insurers would be able to trade insurance futures for their own accounts, there would be a incentive to exploit this

information. The fear of manipulation of the set of policies offered and of the exploitation of private information could be fatal to the contracts' success.

Finally, there are practical problems with an index which does not have a long history. In order to use the contracts, insurers would have to calculate the correlation between their loss experience and the futures index in order to decide on a hedge ratio. If there are no data with which to calculate such a correlation, insurers would have to either wait for the data to accumulate or guess at the correct hedge ratio. Further, there is no reason to believe that the correlation between the paid loss ratio on a small sample of business from selected insurers written in one given month of the year would be highly correlated with the full year of incurred losses the company wants to hedge. Pricing problems of one insurer in the sample may not affect other insurers. The experience of business written in a particular month may not correspond with experience on business written throughout the year.

In short, three fundamental problems are associated with generating a new index as the basis for the insurance futures: 1) encouraging insurers to provide information and 2) dealing with the informational asymmetries resulting from having market participants responsible for providing input to the index, and 3) the inability to calculate a hedge ratio. A better alternative would be to base the insurance futures on a pre-existing index. Such an index should be available over a lengthy historical period, represent

nondiversifiable risk and, to the greatest extent possible, not provide any participant with the ability to manipulate or with superior knowledge. The next section proposes an index that meets these criteria.

A Catastrophe Index

The insurance futures contract proposed in this paper is based on annual aggregate insured losses from catastrophes. The insurance industry already collects detailed statistical information on losses from catastrophes, so creating the index should not be a problem. Further, insurers are already familiar with the historical behavior of catastrophe losses. Thus, this contract would avoid many of the problems with the initially proposed futures problems.

Whenever a windstorm, flood, earthquake or other natural disaster is expected to generate more than a particular level of insurance claims (currently $5 million), the statistical agencies assign a catastrophe number to the event and require all insurers to include this number on claims caused by this catastrophe. Estimates are made of the total insured damages caused by each catastrophe. Aggregate figures are published annually by the Insurance Information Institute and other sources. Figure 1a illustrates the loss payments made as a result of catastrophic losses for the period 1949 - 1988 and Figure 1b extends the results through 1991. Including Hurricane Hugo, which generated $4.2

billion in insured losses in September, 1989, on the chart changes the scale enough to reduce the visual impact of prior catastrophes.

The annual aggregate insured losses from catastrophes could serve as an effective insurance futures index. We would exclude losses from fires and riots from this index for reasons discussed below, dealing only with "natural" catastrophes: hurricanes, tornadoes, hail, ice storms and earthquakes are typical causes. The annual aggregate insured losses from all catastrophes and from natural catastrophes is graphed in Figure 2. The number and severity of natural disasters are unsystematic.

In this proposal the payoff on a catastrophe futures contract is equal to 1/1,000 times the total insured loss payments from natural catastrophes in each calendar year. A contract of this size would have had an average settlement value of about $2.2 million over the period 1978 - 1991. If losses were less than expected, the buyer of a futures contract would incur a loss; if they were greater than expected, the buyer would have a gain.

There would be a 1993 catastrophe future, a 1994 future, etc. Trading would commence shortly before the calendar year begins, in mid-December, and final settlement would take place at the end of March of the following calendar year, by which time a fairly precise estimate of the final figure would be available, since most claims would have been settled. Thus, the right-hand bars in Figure 2 would illustrate the final settlement value on the futures contract from year to year.

An insurer or reinsurer would be able to hedge against swings

in the level of his loss payments by buying an appropriate number of the futures contracts. In a year with heavy claims, the futures position would show a gain which would help offset large payments to policy holders. In a year when claims were light, the futures contract would show a corresponding loss. Most hedgers would probably maintain a continual hedge, switching their position to a new contract near the start of the year. An insurer or reinsurer could establish the number of futures needed for hedging based on the following year's expected market shares of property insurance. An insurer that writes 3.5 percent of the property insurance market could expect to pay approximately 3.5 percent of any catastrophe losses. By purchasing 35 catastrophe futures, any divergence from the expected catastrophe loss experience will be approximately offset by the investment gain or loss on the futures contract.

For instance, if catastrophe losses turned out to be $3 billion rather than $2.2 billion, the insurer's catastrophe losses would be approximately $105 million (i.e., 3.5 percent of $3 billion) rather than $77 million (i.e., 3.5 percent of $2.2 billion). An insurer that bought 35 futures contracts would gain ($3 billion - $2.2 billion) times 1/1000 per contract on each of 35 contracts, for a total of $28 million. Thus the gain on the futures contract would tend to offset the loss due to the catastrophe. If catastrophe losses were lower than expected, the favorable experience would be offset by a loss on the futures contract.

Establishing the value of the contract would be relatively

easy. The mechanism for tracking losses from catastrophes is already in place. When a disaster occurs which is expected to result in more than $5 million of insured losses, it is assigned a catastrophe number, and all insurers are required to report the amount of loss payments resulting from that catastrophe. The data are currently collected and reported by the American Insurance Services Group, Property Claim Services Division. Since this index is based on the reports of all insurers, it would not be easily manipulated by any one company or individual.

Most of the disasters which are classified as catastrophes are the result of tornadoes and hurricanes, with the latter accounting for the most extreme losses. Both types of windstorms have regional and seasonal patterns, tornadoes occurring most often in the southern and central states, with hurricanes largely striking the East coast. Tornadoes occur all year round, but are more likely in spring and summer, while hurricanes are more frequent in late summer and early fall. While hurricanes create the largest individual losses, as can be seen in Figures 1a and 1b, tornadoes are so much more common that they represent a larger proportion of the annual totals.

Up until 1982, a catastrophe number was assigned when insured losses were expected to exceed $1,000,000. In 1982, this trigger value was changed to $5,000,000. Although the trigger for determining a catastrophe has changed, and will continue to change, over time, knowledge of the distribution of losses would allow an adjustment factor to be calculated for different catastrophe level

determinations.

Who Would Trade?

Both speculative and hedging interest in the contract would probably be light before the calendar year covered by the contract begins. Insurers would use futures to hedge loss experience during the year; prior to the beginning of the year any change in the value of the contract would not correspond with actual losses. Also, prior to the start of the calendar year covered, little information about expected catastrophe losses is likely to emerge. Though hurricanes and tornadoes are more likely at some times of the year than at others, long range predictions of deviations from the seasonal pattern do not seem to be reliable. Traders taking the short side of the contract in December would have no special information yet, but would be simply accommodating the hedgers, possibly in exchange for a risk premium.

However, when a tropical storm forms in the Atlantic, a surge in speculative interest should occur. The traders in the grain pits at the Chicago Board of Trade have been assessing the impact of weather for over a hundred years. The traders at the Citrus Associates of the New York Cotton Exchange are so good at predicting the temperature in Florida that there is some evidence they can out-predict the National Weather Service forecast (Roll, 1984). Adequate speculative interest in a contract is considered vital to its success, since it helps increase and maintain market

liquidity.

There are two parts of the insurance industry who would be especially interested in using this contract for hedging their risks. For an insurer, the contract would provide an alternative to reinsurance. A long position in insurance futures would result in an inflow of capital in years when claims are higher than usual, and an outflow when claims are lower. Thus, for most insurers, the futures contract would simply provide an alternative to reinsurance. However, for the largest insurers, the reinsurance market is not cost-effective; they currently tend to bear most of the risk for the policies they write. If the futures market proves to be sufficiently liquid, it might allow the largest insurers to manage their risks in a more efficient manner.

The second group of potential hedgers are the reinsurers themselves, discussed in detail below. First, some reinsurance contracts pass off a proportional amount of claims from the originator. By purchasing shares of claims from many companies, the reinsurer can gain some geographical diversification. Small local claims should average out. However, catastrophes typically cover several states. Even reinsurers would experience such events as large, undiversifiable shocks. An insurance futures contract would enable them to partially offset such risks, if they wished. It is precisely this type of undiversifiable risk which futures were made to take care of: if the price of wheat rises or falls, the shock hits the whole country.

Property insurers of all types, automobile, homeowners and

commercial property, are affected by catastrophic losses. Insurers that are well diversified geographically, and reinsurers, would be likely to have loss experience that varies in line with the national level of catastrophes in a given year. For smaller insurers, especially those not geographically diversified, loss experience will not be as highly correlated with the national catastrophe level. However, for small insurers, the reinsurance market is an effective tool for reducing risk. Insurance futures would be an effective risk reduction tool for organizations for which reinsurance is not as useful a tool, due to their size or their organization.

Another factor that would help create liquidity for a market in catastrophe futures is the fact that these catastrophes actually benefit some segments of the economy, so they might willingly trade the opposite position from insurers. Whereas property insurers suffer losses when these events occur, industries such as building supply firms and construction companies would be expected to incur gains. Also, hedging possibilities with other futures, such as crops also affected by the disaster, may serve to reduce overall risk from positions in an insurance future based on this catastrophe index.

Moral Hazard

The last thing the exchanges would want is to give someone an incentive to cause a major disaster. To avoid moral hazard, the

contract should be written to cover natural catastrophes only. This would exclude from the index the few large fires and occasional riots, which are typically a very small amount of the total loss payments from catastrophes. As shown Figure 2, most catastrophe losses are due to natural occurrences.

There is still some element of moral hazard in catastrophe insurance, but only in that some losses could be avoided, fraudulent claims could be made, or reporting could be more or less complete. However, these reflect the moral hazard of the insured, not the insurers. The only way an insurer would be able to benefit by misreporting or manipulating the catastrophe index would be to have a futures position so much in excess of its exposure to catastrophe losses that it actually paid to do so. This unlikely scenario could easily be prevented by setting position limits on the contract itself, or by direct regulatory oversight. Further, the insurance companies, which originate the statistics on which the index would be based, are closely regulated at the state level. Opportunities for manipulation are probably small.

Insurance Futures versus Reinsurance

The standard method for dealing with excessive risk for an insurance company is to purchase reinsurance. In a reinsurance contract the insurance company that wrote the original policy, called the primary or ceding company, transfers some of that risk to another insurance company, called the reinsurer. Some

reinsurers do not write any primary business; they only accept reinsurance. Other reinsurers write both primary and reinsurance business.

Several different types of reinsurance contracts are available. Under an excess-of-loss contract, the reinsurer pays for any loss on an individual policy over a pre-established value, called the primary insurer's retention level. A primary insurer that wrote a policy with limits above the level it could comfortably handle would reinsure the amount of loss over the retention level. For example, a primary insurer could write a fire insurance policy on a $2 million building, but might feel that a fire loss of over $500,000 would affect its financial status excessively. This insurer could purchase a $1.5 million excess-of-loss reinsurance policy over a $500,000 retention. The primary insurer would pay all losses under $500,000 and the first $500,000 on any loss over the retention.

Another form of reinsurance is pro-rata reinsurance. Under pro-rata reinsurance, the primary insurer and the reinsurer share all losses, regardless of the size, in the same proportions. In the example above, if a primary insurer wanted to limit its maximum loss on the fire policy to $500,000 through pro-rata reinsurance, it would cede 75 percent of every loss to a reinsurer. Since the reinsurer is paying on every claim, not just the large losses, pro-rata reinsurance is much more expensive than excess-of-loss reinsurance. Pro-rata reinsurance is generally used to meet other needs of the primary insurer, such as surplus relief or obtaining

underwriting and pricing guidance from the reinsurer, in addition to reducing the impact of a large loss.

Excess-of-loss and pro-rata reinsurance deal with claims that arise on individual policies. Other forms of reinsurance are available to deal with risk on the total portfolio of the primary insurer. Aggregate excess, also termed catastrophe reinsurance, applies to all losses an insurer incurs from any one event no matter how many different policies are involved. If a primary insurer purchased a $5 million aggregate excess reinsurance policy with a $1 million retention, and one hurricane caused $3.5 million in covered claims on 80 different policies, all the losses over the $1 million retention would be covered by the reinsurer. However, if the hurricane caused $7 million in losses, the reinsurer would pay only the $5 million coverage limit.

Finally, stop-loss reinsurance provides protection against the loss ratio of the primary insurer exceeding a predetermined level. No matter how many different losses occur or how large the individual claims are, the stop-loss reinsurance would begin to pay if the loss ratio were over the set level. A primary insurer might obtain a stop-loss reinsurance contract that started paying 80 percent of all losses when the loss ratio exceeded 85 percent.

Reinsurance is an accepted method of risk transfer for insurers. Insurance regulators analyze the retention levels of an insurer during financial audits and consider the financial status of the reinsurers. In statutory accounting reinsurance recoverable is a recognized asset. Thus, reinsurance effectively reduces the

variability of the primary insurer's underwriting profitability.

Direct written premiums are the total premiums on all policies that a primary insurance company writes. Reinsurance premiums, either ceded or assumed, are not included in direct written premium. Net written premium is equal to direct written premium plus any reinsurance premiums written minus any reinsurance premiums ceded. Thus, a company that buys a lot of reinsurance would have a net written premium figure well below its direct written premium level.

One financial value that insurance regulators monitor for property-liability insurers is the premium to surplus ratio, which is calculated by dividing the net written premium by the statutory surplus of the insurer. If this ratio is above 3.0, then it is considered unusually high. Generally, property-liability insurers have values in the 1.5 to 2.0 range. One regulatory quick screen of the property-liability insurance industry is termed IRIS (Insurance Regulatory Information System), under which a series of financial ratios for each company is determined and the number of unusual values tallied. If four or more unusual values occur for an insurer, then the company is accorded greater scrutiny to determine if a serious financial problem exists. The premium to surplus ratio is one such test.

By purchasing reinsurance, an insurer can lower its net written premiums and reduce the premium to surplus ratio. Thus, reinsurance is an acceptable method for improving the financial position of an insurer.

The initial CBOT insurance futures contract was advanced as a low cost alternative to reinsurance. However, the index on which the future was to be based would, at most, be only somewhat correlated with the loss experience of an individual insurer. Unlike reinsurance, which is perfectly correlated with the primary insurer's loss experience, the futures would only be an approximate hedge for loss experience. Insurance regulators did not view insurance futures as an acceptable alternative to reinsurance. Investments in insurance futures were not allowed to reduce net written premiums and required loss reserves would not be affected by a position in insurance futures. This position was in part due to the conservative nature of insurance regulation, evidenced by an unwillingness to accept a new technique in place of a well established one, as well as the valid recognition that insurance futures were a far less precise hedging mechanism than reinsurance.

The primary problem with the view that insurance futures can be an alternative to reinsurance is the failure to recognize that reinsurance affects the underwriting side of an insurer and futures, insurance or otherwise, affect the investment side of insurance. Both the dichotomy of insurance underwriting and investment operations and the risk reducing possibilities available by properly structuring the investment portfolio have been examined previously [Tilley (1980), D'Arcy (1982), Panning (1987), Casualty Actuarial Society (1990) Chapter 8]. If an insurer purchases an investment that is positively correlated with losses, then the total risk of the insurer will be reduced. When losses are higher

than expected, the investment will produce an above average gain; when losses are below expectations, investment results will also be below average. Thus, total profitability will be less volatile under this investment strategy.

For a primary insurer, the purchase of a catastrophe future would be similar to buying a proportional reinsurance contract on an industry aggregate excess basis. The difference would be that reinsurance affects underwriting results, whereas catastrophe futures would have a risk reducing effect though investment income. An option on a catastrophe future, which the CBOT would probably also offer, would be similar to an excess-of-loss reinsurance contract on an industry aggregate excess basis.

Insurers can invest in futures and options under the regulations of most states, although the amount of such investments are limited to a set percentage of surplus or assets. These investments are treated similarly to an equity investment and valued at market values for each accounting period. A future that is correlated with insurance losses would thus be an attractive investment opportunity for an insurer. No additional regulatory approval, or sanction as an alternative to reinsurance, would be necessary.

How Good a Hedge?

An insurance futures contract is only useful if the value of the contract tracks closely the risk to be hedged. Though catastrophe futures have many desirable properties, insurer losses

from catastrophes do not represent a high proportion of the total losses to insurers. They can still represent a useful hedge, however, if changes in the futures contract value are closely correlated with changes in the profitability of insurers.

We have identified two groups of insurers who would seem likely to benefit from a catastrophe futures contract, large insurance companies and reinsurers. Large insurance companies are poorly served by the reinsurance market because of the size of their exposures, but might be able to benefit from insurance futures if the market were sufficiently liquid.

Reinsurers might be also be able to use insurance futures to hedge themselves. First, since pro-rata reinsurance involves holding a portion of a large number of contracts, reinsurers' loss experience is likely to correlate relatively closely with the overall catastrophe record. Second, aggregate excess reinsurance leaves the reinsurer exposed to catastrophic type losses. For these contracts, catastrophe futures are an even more obvious hedge. The correlation between the reinsurance contract's profitability and total losses on catastrophes should be high, which would make the futures contract a good hedging instrument.

Empirical Results

As mentioned previously, insurance claims paid in catastrophic losses are tabulated by the Property Claim Service Division of the American Insurance Services Group and cited in various sources,

including Insurance Facts, published annually by the Insurance Information Institute. Although these values are only estimates of insured losses, they represent reasonable approximations of the cost to insurers of catastrophic losses. This information has been compiled for over 40 years, so a significant loss history is already in existence.

The types of natural disasters that tend to cause significant insurance losses include wind, hail, tornadoes, earthquakes, floods and blizzards. These losses are covered under property insurance policies, which are reported as a number of different lines of insurance in financial reports. Each line would also include other types of losses. This study considers the major lines under which catastrophe losses would fall: Fire, Allied Lines, Homeowners and Commercial Multi-Peril.

In addition to natural disasters, fires can also be of catastrophic proportions. For example, the brush fires in the San Francisco area in October, 1991, were estimated to have caused $1.2 billion in insured losses, second only to Hurricane Hugo in overall size. However, fires are excluded from our measure of natural disasters to reduce moral hazard in trading catastrophe futures. Otherwise, an investor holding a long position in catastrophe futures might be tempted to set a major fire to increase the value of the futures.

Statutory underwriting profit margins from Best's Aggregates and Averages for stock insurers and mutual insurers and for the largest primary insurers were obtained for the period 1960-1990 for

each of these lines of business. The effect of catastrophes on smaller insurers is expected to be less than on the largest insurers as small insurers would purchase reinsurance to reduce the impact of catastrophic losses. The largest insurers tend to retain all or most of the catastrophe losses.

The catastrophe losses occurring annually from natural disasters are deflated to remove the impact of inflation. The deflated values still exhibit an upward trend, likely the impact of increasing insured property values in at risk localities, such as coastal areas [ISO (1990)]. A line fitted to the deflated catastrophes, as shown on Figure 3, has a significant positive coefficient.

In 1989 natural disasters, led by hurricane Hugo, caused $7.6 billion in insured losses, a value significantly higher than the trend of the prior 38 years would have indicated. In 1990, insured losses from natural disasters totaled $2.8 billion, a value as high as any prior year other than 1989. Whether these values portend a new level of losses or are simply outliers is difficult to tell at this point. However, to prevent these unusually large values from distorting the calculations, all the analyses are run for the period 1960-1988 and for 1960-1990.

Using the trended value of natural disasters as the "normal" catastrophe loading, any deviation from this level would be expected to impact underwriting profitability. If the actual level of catastrophes is less than the trended level, underwriting profitability should increase. A higher level of catastrophes

would translate into reduced profitability.

The impact of catastrophes is measured against underwriting profitability, rather than simply incurred losses, due to the downward trend of underwriting expenses over the time period of this study. Insurers have lowered commissions and become more efficient in other expense areas over the period of this study, and insurers with lower expense ratios have gained market share. For example, in 1960 the all lines expense ratio for stock insurers was 34.8 percent; by 1988 this ratio had fallen to 27.8 percent. As lower expenses allow insurers to operate profitably at higher loss ratios, the underwriting profit margin is a more valid measure of deviation from expected results than only changes in the loss ratio.

The correlations of underwriting profitability for Fire, Allied Lines, Homeowners and Commercial Multi-Peril for all stock insurers, all mutual insurers and for the largest primary insurers are reported in Table 1. Roughly half (25 of 40 for 1960-1988 and 19 of 40 for 1960-1990) of the correlations are significant at the 5 percent level. Allied Lines, Homeowners and Commercial Multi-Peril tend to have significant correlations, but Fire Insurance, despite the fact the extended coverage endorsement provides windstorm coverage, does not. A similar pattern exists for most large insurers.

The insignificant values for Fire could be the result of excluding fire catastrophes, or from expense ratio anomalies. The Fire insurance expense ratio for mutual insurers did move

unexpectedly. For example, in 1985 the ratio was 24.9 percent and in 1986, 48.4 percent. For individual insurers low correlations could be the result of reinsurance contracts that dampen the effect of catastrophic losses, the occurrence of large, company specific disasters or expense ratio movements. Communications with one large insurer in the sample, Liberty Mutual, indicated that expense ratio fluctuations could not be reasonably explained and their Allied Lines book of business was small enough to be severely impacted by individual losses. Another explanation could be the relatively minor impact of catastrophic losses on some lines that cover many perils. For example, Homeowners and Commercial Multi-Peril cover liability in addition to property losses. Liability losses, especially for CMP, could dwarf the impact of property loss fluctuations caused by catastrophes. Also, the long tailed nature of liability claims increases the impact of interest rate changes on the acceptable underwriting profit margin for an insurer. The general upward trend of interest rates over the period studied, as well as interest rate cycles, create an additional distortion to the underwriting profit margin.

Reinsurers' experience is also expected to be affected by catastrophic losses, and to a greater extent than primary insurers. However, accounting for reinsurance transactions does not always follow the same line of business allocations as the primary policy represents. The analysis of the correlation of reinsurers' underwriting profitability with the deviation from trended catastrophes, as shown in Table 2, shows a negative, but

insignificant, effect for most reinsurers for the period 1960-1990. For the period 1960-1988, the correlations for five of the seven reinsurers are significant at the 5 percent level. The effect of catastrophic losses for reinsurers is likely to be dampened by combining results of all lines of business. Also, the distorting effects of interest rate changes on target underwriting profit margins and external influences on the reinsurance market, such as tax law changes, dilute the correlation of underwriting profits with catastrophic losses. The ideal value to measure the correlation of unexpected catastrophe losses against would be a company's unexpected property losses for a year. Based on projected premium volume by line and past property losses, an insurer or reinsurer could project an expected level of property insurance losses. The difference between actual losses and the expected value would represent unexpected losses, and this value could be positive or negative. Some of the unexpected losses would result from the level of natural disasters being above or below normal. This deviation could be hedged by the use of catastrophe futures. The correlation between the level of natural disasters and unexpected insurance losses would allow an insurer to develop an accurate hedge ratio.

Conclusion

Solvency is a prime concern of insurance regulators. The development of a viable insurance futures contract would provide

insurers with additional opportunities to reduce the risk of insolvency. This market may prove as essential for insurance management as the use of interest rate futures is for banks. Banking regulators now encourage banks to use interest rate futures to control their exposure to interest rate shocks.

Some insurers already use financial futures (Hoyt, 1989), although the number is relatively low so far. Reasons for this low participation probably include both unfamiliarity with these markets and the lack of appropriate risk reducing mechanisms. The CBOT's insurance futures are unlikely to change this situation.

In this paper an index for an insurance future that avoids the problems of the CBOT proposal and provides a demonstrated risk reducing method for insurers is presented. A catastrophe future, based on an index of insured losses in natural disasters, would allow insurers to reduce the variability of total profitability. This index would have an historical record, lower administrative costs and a higher correlation with profitability than the CBOT proposal, and also avoid the asymmetric information problem inherent in the CBOT proposal. Insurance futures are far more likely to become successful financial innovations if the index were to be based on an existing value, such as insured catastrophe losses, than if based on an index generated by a new data collection process. This preliminary analysis suggests that catastrophe futures provide a promising hedge for some of the larger insurance companies and reinsurers.

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Figure 1a: Catastrophe Losses

January 1949-December 1988

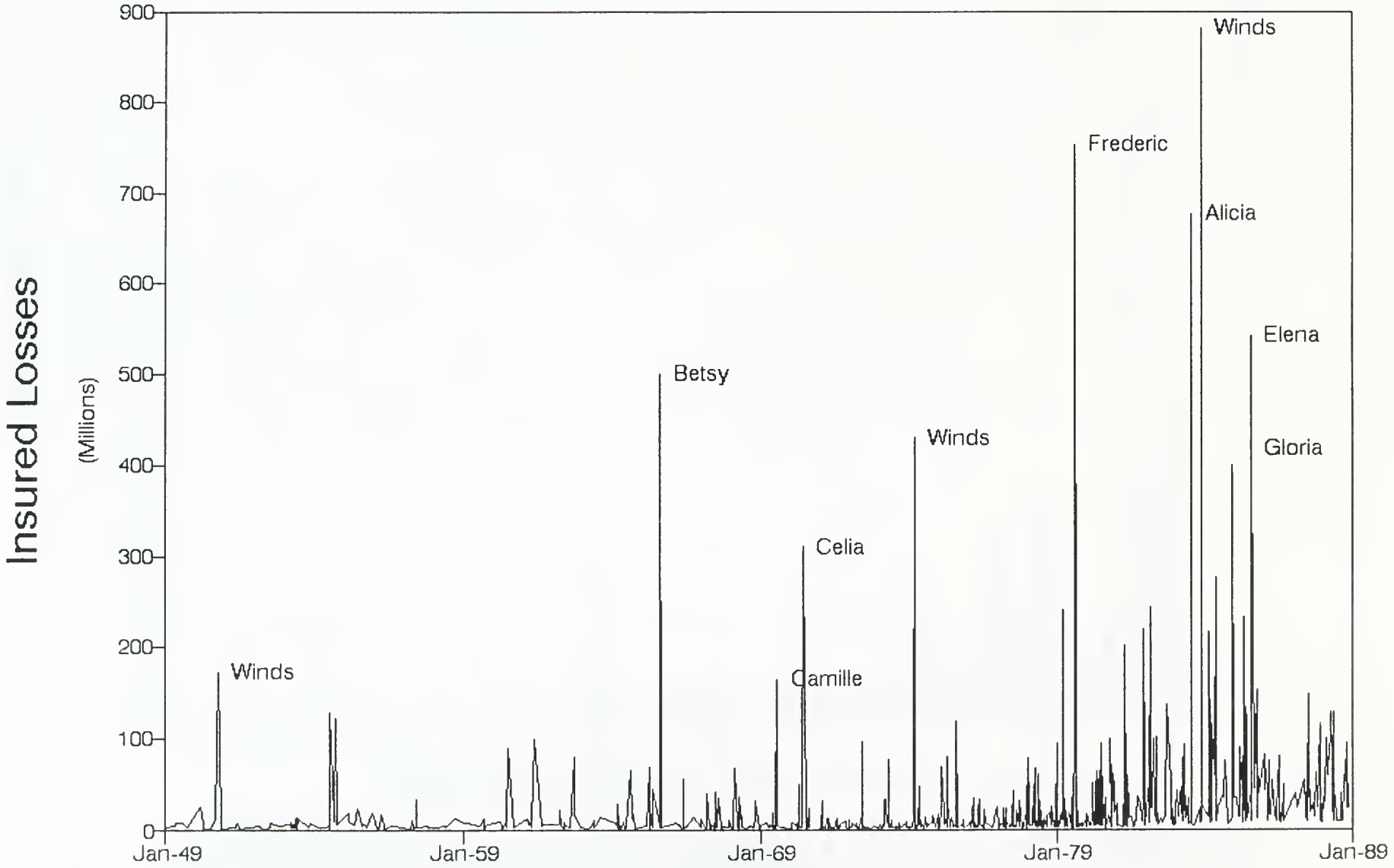

Figure 1b: Catastrophe Losses

January 1949-December 1991

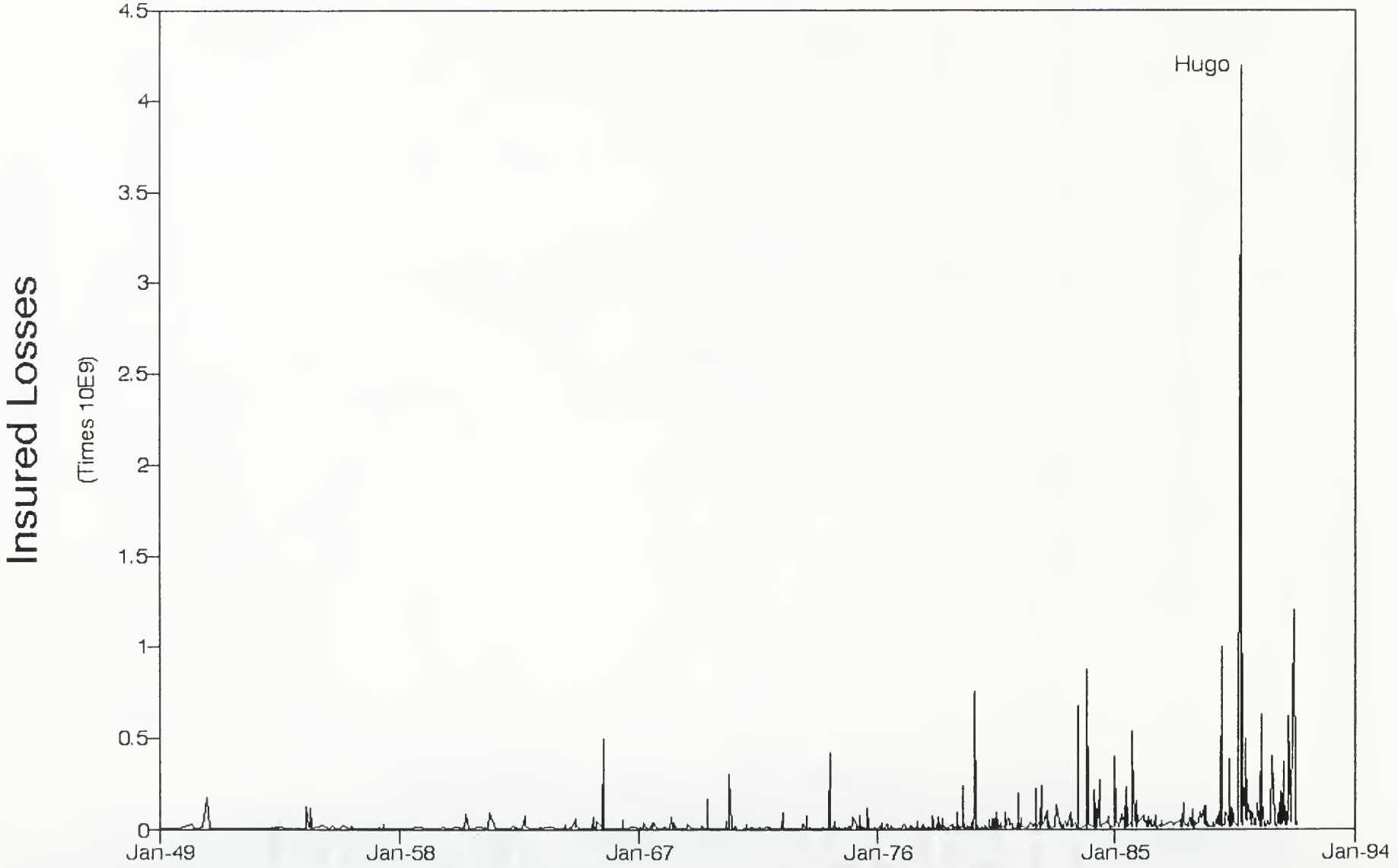

Fig. 2: Natural vs All Insured Losses

from Catastrophes

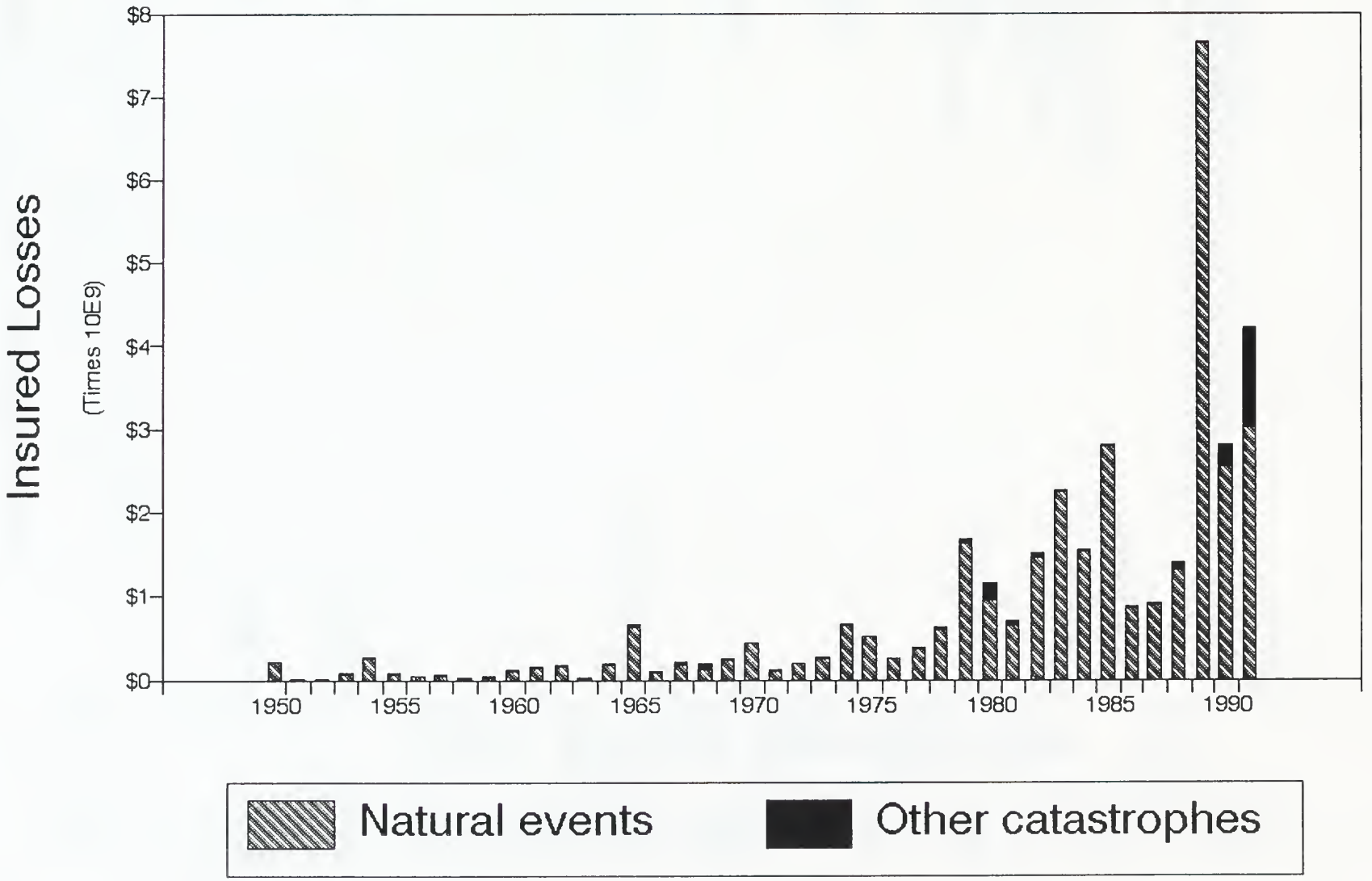

Fig. 3: Real Insured Losses
from Natural Catastrophes

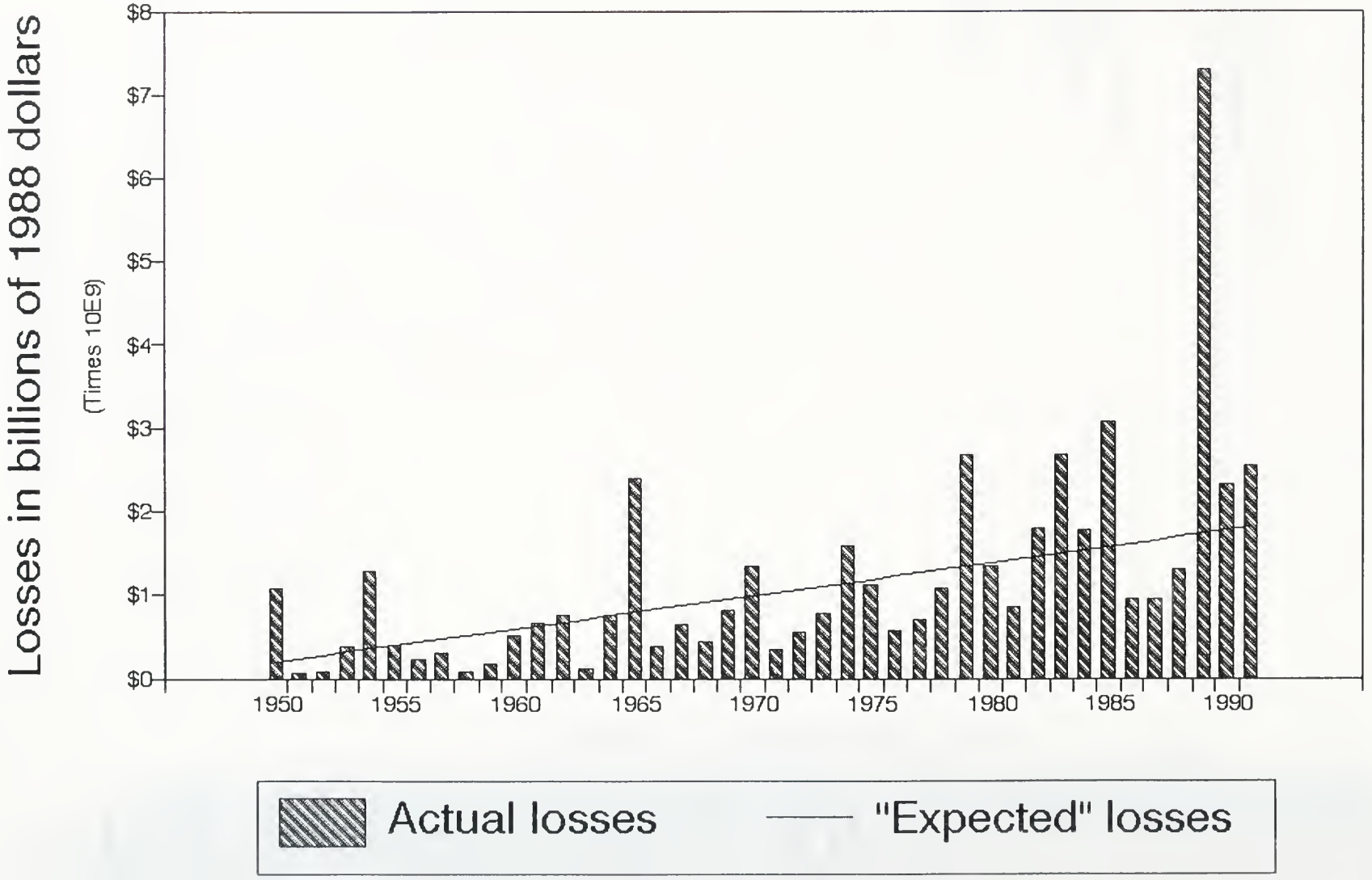

Fig. 4: "Unexpected" Insured Losses

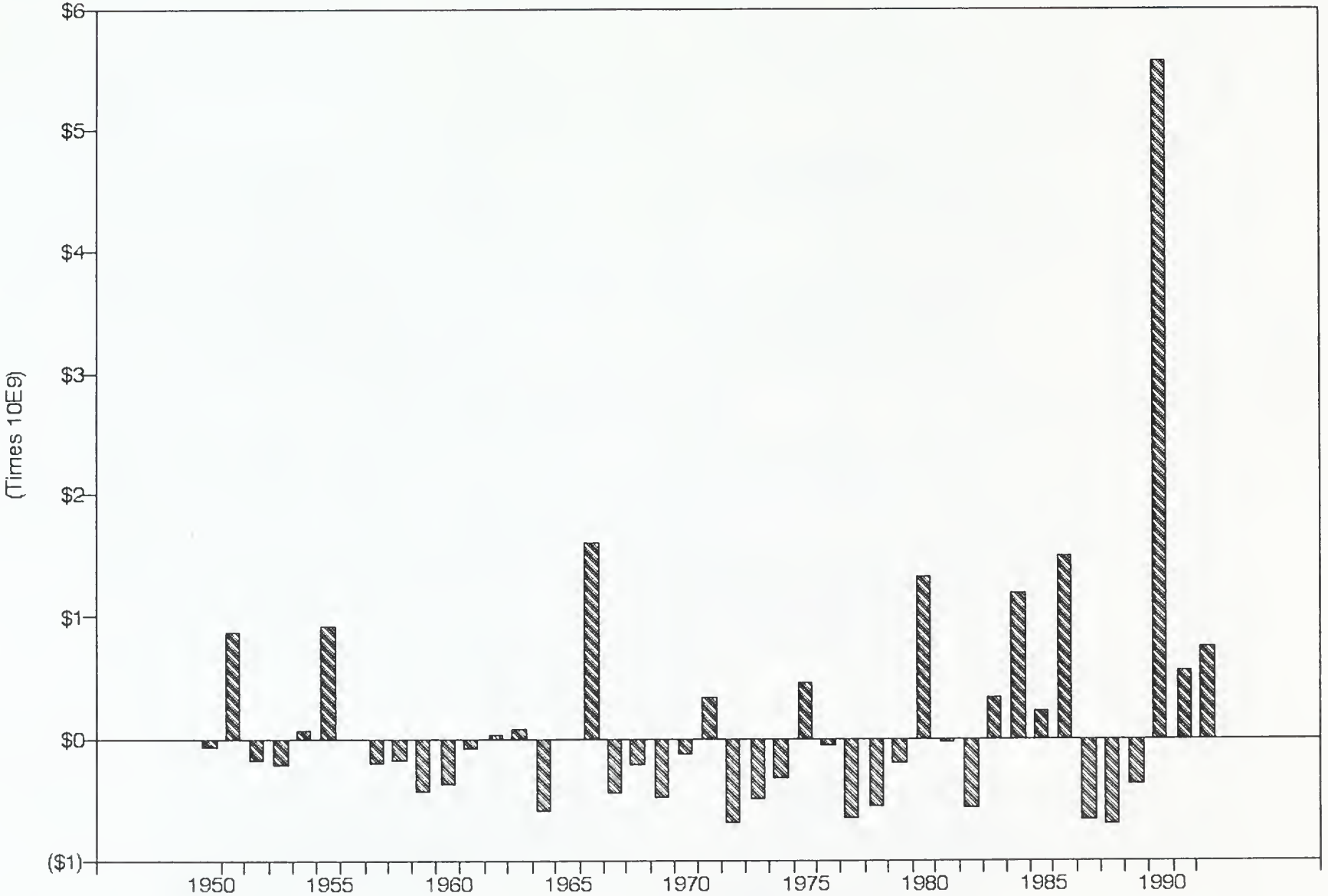

TABLE 1

RELATIONSHIP BETWEEN UNEXPECTED NATURAL LOSSES AND UNDERWRITING PROFIT MARGINS - PRIMARY INSURERS

FIRE INSURANCE

	1960-1988			1960-1990		
	R-squared	T-statistic	Corr:	R-squared	T-statistic	Corr:
STOCKS	0.1192	-1.912*	-0.3453	0.0659	-1.431	-0.2568
MUTUALS	0.0340	-0.975	-0.1844	0.0529	-1.273	-0.2300
STATE FARM	0.0096	-0.512	-0.0981	0.0278	-0.910	-0.1666
ALLSTATE	0.0078	-0.460	-0.0882	0.0088	0.508	0.0939
AETNA	0.0219	-0.777	-0.1479	0.3295	-3.775**	-0.5740
LIBERTY MUTUAL	0.1586	-2.256*	-0.3982	0.0274	-0.904	-0.1656
NATIONWIDE	0.0353	-0.994	-0.1879	0.0220	-0.808	-0.1484
HARTFORD	0.1445	-2.136*	-0.3802	0.0173	-0.714	-0.1314
TRAVELOR'S	0.0080	-0.489	-0.0936	0.1610	-2.359*	-0.4012
CNA	0.0265	-0.857	-0.1627	0.0028	0.283	0.0525
AMER.-INT'NL	0.0163	-0.670	-0.1278	0.1984	-2.679**	-0.4454

* significant at 5% level (one tailed)
** significant at 1% level (one tailed)

ALLIED LINES

	1960-1988			1960-1990		
	R-squared	T-statistic	Corr:	R-squared	T-statistic	Corr:
STOCKS	0.4439	-4.642**	-0.6662	0.5562	-6.028**	-0.7458
MUTUALS	0.2356	-2.885**	-0.4854	0.2506	-3.114**	-0.5506
STATE FARM	0.3629	-3.922**	-0.6924	0.1569	-2.323*	-0.3961
ALLSTATE	0.1361	-1.985*	-0.3690	0.2248	-2.798**	-0.4741
AETNA	0.2965	-3.373**	-0.5445	0.3294	-3.774**	-0.5739
LIBERTY MUTUAL	0.0062	0.410	0.0786	0.0085	-0.500	-0.0924
NATIONWIDE	0.1237	-1.952*	-0.3516	0.1702	-2.439*	-0.4125
HARTFORD	0.0213	-0.767	-0.1461	0.2181	-2.844**	-0.4670
TRAVELOR'S	0.0776	-1.507	-0.2786	0.1258	-2.043*	-0.3547
CNA	0.1315	-2.022*	-0.3627	0.0616	-1.380	-0.2482
AMER.-INT'NL	0.2284	-2.827**	-0.4780	0.3573	-4.015**	-0.5977

* significant at 5% level (one tailed)
** significant at 1% level (one tailed)

HOMEOWNERS

	1960-1988			1960-1990		
	R-squared	T-statistic	Corr:	R-squared	T-statistic	Corr:
STOCKS	0.2166	-2.732**	-0.4654	0.3049	-3.567**	-0.5522
MUTUALS	0.2859	-3.288**	-0.5347	0.1122	-1.915*	-0.3350
STATE FARM	0.1854	-2.479**	-0.4306	0.2248	-2.900**	-0.4742
ALLSTATE	0.0836	-1.570	-0.2892	0.0721	-1.501	-0.2685
AETNA	0.1294	-2.003*	-0.3597	0.3233	-3.722**	-0.5686
LIBERTY MUTUAL	0.0075	-0.451	-0.0865	0.0581	-1.338	-0.2411
NATIONWIDE	0.0405	-1.067	-0.2012	0.0269	-0.895	-0.1639
HARTFORD	0.1594	-2.263*	-0.3993	0.1293	-2.075*	-0.3596
TRAVELOR'S	0.0050	-0.368	-0.0706	0.0162	-0.690	-0.1272
CNA	0.2369	-2.895**	-0.4867	0.0778	-1.564	-0.2790
AMER.-INT'NL	0.0291	-0.900	-0.1707	0.1644	-2.389*	-0.4055

* significant at 5% level (one tailed)
** significant at 1% level (one tailed)

COMMERCIAL MULTI-PERIL

	1960-1988			1960-1990		
	R-squared	T-statistic	Corr:	R-squared	T-statistic	Corr:
STOCKS	0.2152	-2.721**	-0.4638	0.0637	-1.404	-0.2523
MUTUALS	0.1458	-2.147*	-0.3819	0.0293	-0.936	-0.1712
STATE FARM	0.1707	-2.314*	-0.4132	0.1372	-2.110*	-0.3704
ALLSTATE	0.1180	-1.829*	-0.3435	0.0099	-0.519	-0.0993
AETNA	0.2057	-2.644**	-0.4536	0.0553	-1.303	-0.2353
LIBERTY MUTUAL	0.0813	-1.546	-0.2852	0.0272	-0.901	-0.1650
NATIONWIDE	0.1112	-1.803*	-0.3335	0.0271	-0.884	-0.1647
HARTFORD	0.0820	-1.553	-0.2865	0.0436	-1.150	-0.2089
TRAVELOR'S	0.1640	-2.301*	-0.4049	0.0499	-1.234	-0.2234
CNA	0.1627	-2.291*	-0.4034	0.0158	-0.682	-0.1256
AMER.-INT'NL	0.0733	-1.461	-0.2707	0.0072	0.458	0.0847

* significant at 5% level (one tailed)
** significant at 1% level (one tailed)

TABLE 2

RELATIONSHIP BETWEEN UNEXPECTED NATURAL LOSSES AND UNDERWRITING PROFIT MARGINS - REINSURERS

	1960-1988			1960-1990		
	R-squared	T-statistic	Corr:	R-squared	T-statistic	Corr:
GENERAL RE	0.0968	-1.701*	-0.3111	0.0002	-0.085	-0.0158
EMPLOYER'S RE	0.0370	-1.018	-0.1923	0.0033	0.308	0.0571
AMERICAN RE	0.1712	-2.362*	-0.4138	0.0121	-0.595	-0.1099
SWISS RE	0.2558	-3.047**	-0.5058	0.1233	-2.019*	-0.0511
MUNICH RE	0.1844	-2.470**	-0.4294	0.1098	-1.891*	-0.3314
ST.PAUL COS.	0.1293	-2.003*	-0.3596	0.0172	-0.713	-0.1312
TRANSATLANTIC-PUTNAM RE	0.0944	-1.677	-0.3072	0.0353	-1.030	-0.1878

* significant at 5% level (one tailed)
** significant at 1% level (one tailed)

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